WHAT IS CLAIMED IS:

1. A system of generating a finite element mesh for a threaded fastener and joining structure assembly comprising:

a computer system, wherein said computer system includes a memory, a processor, an input device and a display device;

a mesh model of the threaded fastener and joining structure assembly generated on the computer system wherein nodes and elements for each non-threaded portion of the threaded fastener and joining structure assembly are created using cylindrical coordinates and nodes and elements for each threaded portion of the threaded fastener and joining structure assembly are created using helical coordinates;

a finite element model of the mesh model of the threaded fastener and joining structure assembly generated on the computer system using finite element analysis;

a user evaluating the finite element model using the computer system; and

the user using the computer system to predict a stress of the threaded fastener and joining structure assembly from the evaluation of the result of the finite element analysis.

2. A system as set forth in claim 1 wherein said mesh model of the threaded fastener and joining structure assembly includes a mesh generated for a fastener joining together a clearance hole block and a threaded block.

3. A system as set forth in claim 2 including:

the user specifying a parameter describing the fastener, clearance hole block and threaded block;

the user creating a mesh of the fastener on the computer system;

the user creating a mesh of the clearance hole block on the computer system;

the user creating a mesh of the threaded block on the computer system; and

the user checking if the mesh model meets a predetermined criteria.

4. A system as set forth in claim 3, wherein said mesh of the fastener includes:

nodes created in radial, tangential and vertical directions for each non-threaded portion of

the fastener using cylindrical coordinates and elements defined by interconnecting the nodes;

nodes created for each transition portion of the fastener transitioning between the non-threaded portion of the fastener and a threaded portion of the fastener by stretching a hexahedral element in a vertical direction while sweeping about a vertical axis, and elements defined by interconnecting the nodes and interleaving wedge elements at the end of a revolution;

a mesh of the fastener thread generated using helical coordinates; and

nodes for each transition portion of the fastener transitioning between the fastener threads and a non-threaded portion of the fastener created by shrinking a hexahedral element in a vertical direction while sweeping about a vertical axis, and elements defined by interconnecting the nodes and interleaving wedge elements at the end of a revolution.

5. A system as set forth in claim 3, wherein said mesh of the threaded block includes:

nodes created in radial, tangential and vertical directions for each non-threaded portion of

the threaded block using cylindrical coordinates and elements defined by interconnecting the nodes;

nodes created for each transition portion of the fastener transitioning between the non-threaded portion of the threaded block and a threaded portion of the block by stretching a hexahedral element in a vertical direction while sweeping about a vertical axis, and elements defined by interconnecting the nodes and interleaving wedge elements at the end of a revolution;

a mesh of the threaded block threads generated using helical coordinates; and

nodes for each transition portion of the threaded block transitioning between the threaded block threads and a non-threaded portion of the threaded block created by shrinking a hexahedral element in a vertical direction while sweeping about a vertical axis, and elements defined by interconnecting the nodes and interleaving wedge elements at the end of a revolution.

6. A system as set forth in claim 3, wherein said mesh of the clearance hole block includes nodes positioned in radial, tangential and vertical directions for each portion of the clearance

hole block using cylindrical coordinates and elements defined by interconnecting the nodes.

7. A system as set forth in claim 4 wherein a mesh of the fastener threads includes:

a mesh of a first thread of the fastener threads, wherein nodes are created using gradual stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and elements defined by interconnecting the nodes;

a mesh of a thread body of the fastener threads, wherein nodes are created using constant stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and elements defined by interconnecting the nodes; and

a mesh of a last thread of the fastener threads, wherein nodes are created using gradual shrinking on a helix by moving nodes downward to cylindrical coordinates while sweeping about a vertical axis, and elements are defined by interconnecting the nodes.

8. A system as set forth in claim 4 wherein said mesh of the fastener threads includes:

a growth thread profile for the first thread of the fastener threads created by taking a vertical cross-section through a thread between columns of hexahedral elements;

a constant thread profile created using hexahedral elements for the thread body of the fastener threads;

a shrink thread profile created for the last thread of the fastener threads; and

a helical mesh of the fastener threads created by spinning the growth thread profile, constant thread profile and shrink thread profile.

9. A system as forth in claim 5 wherein said mesh of the threaded block threads includes:

a mesh of a first thread of the threaded block threads, wherein nodes are created using gradual stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and elements are defined by interconnecting the nodes;

a mesh of a thread body of the threaded block threads, wherein nodes are created using constant stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a

vertical axis, and elements defined by interconnecting the nodes; and

a mesh of a last thread of the threaded block threads, wherein nodes are created using gradual shrinking on a helix by moving nodes downward to cylindrical coordinates while sweeping about a vertical axis, and elements defined by interconnecting the nodes.

10. A system as set forth in claim 5 wherein said mesh of the threaded block threads includes:

a growth thread profile for the first thread of the threaded block threads created by taking a vertical cross-section through a thread between columns of hexahedral elements;

a constant thread profile created using hexahedral elements for thread body of the threaded block threads;

a shrink thread profile created for the last thread of the threaded block threads; and

a helical mesh of the threaded block threads created by spinning the growth thread profile, constant thread profile and shrink thread profile.

11. A system as set forth in claim 8 or claim 10 wherein said constant thread profile includes:

a mesh of a starting flat profile of a hexahedral element;

a mesh of a transition profile from the flat element to a helical element of the thread created by transitioning between a larger element to smaller elements;

a mesh of a wedge profile wherein additional rows of hexahedron elements are added for thread growth; and

a mesh of a hexahedron and pentahedron elements created where two consecutive profiles correspond.

12. A system as set forth in claim 1 including using the computer to predict a fatigue life of the threaded fastener and joining structure assembly from the evaluation of the result of the finite element analysis.

13. A method of generating a finite element mesh for a threaded fastener and joining structure assembly, said method comprising the steps of:

generating a mesh model of the threaded fastener and joining structure assembly by creating nodes and elements for each non-threaded portion of the threaded fastener and joining structure assembly using cylindrical coordinates and creating nodes and elements for each threaded portion of the threaded fastener and joining structure assembly using helical coordinates;

evaluating the mesh model of the threaded fastener and joining structure assembly using finite element analysis;

evaluating a result of the finite element analysis; and

predicting a stress of the threaded fastener and joining structure assembly from the evaluation of the result of the finite element analysis.

14. A method as set forth in claim 13 wherein said step of generating a mesh model of the threaded fastener and joining structure assembly includes generating a mesh for a fastener joining together a clearance hole block and a threaded block.

15. A method as set forth in claim 14 including the steps of:

specifying a parameter describing the fastener, clearance hole block and threaded block;

meshing the fastener;

meshing the clearance hole block;

meshing the threaded block; and

checking if the mesh model meets a predetermined criteria.

16. A method as set forth in claim 15, wherein said step of meshing the fastener includes the steps of:

creating nodes in radial, tangential and vertical directions for each non-threaded portion of the fastener using cylindrical coordinates and defining elements by interconnecting the nodes;

creating nodes for each transition portion of the fastener transitioning between the non-threaded portion of the fastener and a threaded portion of the fastener by stretching a hexahedral element in a vertical direction while sweeping about a vertical axis, and defining elements by interconnecting the nodes and interleaving wedge elements at the end of a revolution;

generating a mesh of the fastener thread using helical coordinates; and

creating nodes for each transition portion of the fastener transitioning between the fastener threads and a non-threaded portion of the fastener by shrinking a hexahedral element in a vertical direction while sweeping about a vertical axis, and defining elements by interconnecting the nodes and interleaving wedge elements at the end of a revolution.

17. A method as set forth in claim 15, wherein said step of meshing the threaded block includes the steps of:

creating nodes in radial, tangential and vertical directions for each non-threaded portion of the threaded block using cylindrical coordinates and defining elements by interconnecting the nodes;

creating nodes for each transition portion of the fastener transitioning between the non-threaded portion of the threaded block and a threaded portion of the block by stretching a hexahedral element in a vertical direction while sweeping about a vertical axis, and defining elements by interconnecting the nodes and interleaving wedge elements at the end of a revolution;

generating a mesh of the threaded block threads using helical coordinates; and

creating nodes for each transition portion of the threaded block transitioning between the threaded block threads and a non-threaded portion of the threaded block by shrinking a hexahedral element in a vertical direction while sweeping about a vertical axis, and defining elements by interconnecting the nodes and interleaving wedge elements at the end of a revolution.

18. A method as set forth in claim 15, wherein said step of meshing the clearance hole block includes the step of positioning nodes in radial, tangential and vertical directions for each portion of the clearance hole block using cylindrical coordinates and defining elements by interconnecting the nodes.

19. A method as forth in claim 16 wherein said step of generating a mesh of the fastener threads includes the steps of:

meshing a first thread of the fastener threads by creating nodes using gradual stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes;

meshing a thread body of the fastener threads by creating nodes using constant stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes; and

meshing a last thread of the fastener threads by creating nodes using gradual shrinking on a helix by moving nodes downward to cylindrical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes.

20. A method as set forth in claim 16 wherein said step of generating a mesh of the fastener threads includes the steps of:

creating a growth thread profile for the first thread of the fastener threads by taking a vertical cross-section through a thread between columns of hexahedral elements;

creating a constant thread profile using hexahedral elements for the thread body of the fastener threads;

creating a shrink thread profile for the last thread of the fastener threads; and

spinning the growth thread profile, constant thread profile and shrink thread profile into a helical mesh of the fastener threads.

21. A method as forth in claim 17 wherein said step of generating a mesh of the threaded block threads includes the steps of:

meshing a first thread of the threaded block threads by creating nodes using gradual stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes;

meshing a thread body of the threaded block threads by creating nodes using constant stretching on a helix by moving nodes upwards to helical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes; and

meshing a last thread of the threaded block threads by creating nodes using gradual shrinking on a helix by moving nodes downward to cylindrical coordinates while sweeping about a vertical axis, and defining elements by interconnecting the nodes.

22. A method as set forth in claim 17 wherein said step of generating a mesh of the threaded block threads includes the steps of:

creating a growth thread profile for the first thread of the threaded block threads by taking a vertical cross-section through a thread between columns of hexahedral elements;

creating a constant thread profile using hexahedral elements for thread body of the threaded block threads;

creating a shrink thread profile for the last thread of the threaded block threads; and

spinning the growth thread profile, constant thread profile and shrink thread profile into a helical mesh of the threaded block threads.

23. A method as set forth in claim 20 or claim 22 wherein said step of creating a constant thread profile includes the steps of:

meshing a starting flat profile of a hexahedral element;

meshing a transition profile from the flat element to a helical element of the thread by transitioning between a larger element to smaller elements;

meshing a wedge profile to add additional rows of hexahedron elements for thread growth; and

meshing hexahedron and pentahedron elements where two consecutive profiles correspond.

24. A method as set forth in claim 13 including the step of predicting a fatigue life of the threaded fastener and joining structure assembly from the evaluation of the result of the finite element analysis.